1. Consider the equilibrium reactiton:

$2\,NO_{(g)} + O_{2(g)} \rightleftharpoons 2NO_{2(g)}$; $K_c = 7.0 \times 10^5$ at 500 K.

Calculate the value of K_c for the following equilibrium:

$$NO_{2(g)} \rightleftharpoons NO_{(g)} + \tfrac{1}{2} O_{2(g)}$$

a) 3.8×10^{-4} b) 1.2×10^{-3} c) 2.0×10^{-3}

d) 4.3×10^{-5} e) 6.2×10^{-4}

2. Consider the following reaction

$2NO_{(g)} + Br_{2(g)} \rightleftharpoons 2\,NOBr_{(g)}$; $K_c = 0.0472$ at 992 K.

Calculate the value of K_p for same reaction at 992 K.

a) 7.5×10^{-4} b) 1.2×10^{-4} c) 5.8×10^{-4}

d) 4.6×10^{-4} e) 9.0×10^{-4}

3. Consider the equilibrium reaction:

$$N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)}; \quad \Delta H = -24.7 \text{ kJ/mol.}$$

Which of the following effects will increase the amount of NH_3 at equilibrium?

a) Increase the temperature.
b) Decrease the concentration of N_2.
c) Add a catalyst.
d) Decrease the total volume of reaction mixture.
e) Add an inert gas, at same total volume.

4. Consider the following equilibrium at 1320 K:

$$COCl_{2(g)} \rightleftharpoons CO_{(g)} + Cl_{2(g)}$$

When a sample of 0.600 moles of $COCl_{2(g)}$ is placed in a 1.00 L cantainer and the reaction is allowed to reach equilibrium. The equilibrium concentrations of CO was 0.059 M.

Calculate equilibrium constant K_c for the reactionis :

a) 6.4×10^{-3} b) 5.4×10^{-3} c) 9.0×10^{-3}

d) 3.7×10^{-3} e) 7.2×10^{-3}

5. Consider the following equilibrium:

$$2IBr_{(g)} \rightleftharpoons I_{2(g)} + Br_{2(g)}\ ;\ K_c = 0.0256 \text{ at } 100\ ^\circ C.$$

If 1.00 mole of IBr is placed into a 4.00 L vessel at 100 °C and the reaction is allowed to reach equilibrium.
Calculate the molar concentration of Br_2 at equilibrium.

a) 0.076 b) 0.061 c) 0.024 d) 0.048 e) 0.030

6. Which one of the following would be a conjugate acid - base pair?

a) OH^- / H_3O^+ b) H_2SO_4/SO_4^{2-} c) NH_3/NH_2^-

d) NH_3/ OH^- e) H_3PO_4/HPO_4^{2-}

7. Calculate the molar concentration of H^+ in a 0.20 M aqueous solution of hydrazine. Hydrazine, N_2H_4, is a weak base, $K_b = 1.7 \times 10^{-6}$.

a) 1.1×10^{-11} b) 1.4×10^{-11} c) 2.4×10^{-11}

d) 1.7×10^{-11} e) 1.9×10^{-11}

8. A weak acid is 8.00 % ionized in 0.0200M aqueous solution of the acid at 25°C. Calculate pK_a for the acid.

a) 4.24 b) 3.56 c) 3.38 d) 3.16 e) 3.86

9. Calculate the pH of 0.40 M aqueous solution of the diprotic acid H_2A.
For H_2A: $K_{a1} = 2.6\times10^{-5}$ and $K_{a2} = 4.8\times10^{-12}$.

a) 2.49 b) 2.44 c) 2.82 d) 2.55 e) 2.64

10. Calculate the pH of 0.65 M aqueous solution of ammonium nitrate, NH_4NO_3. $K_b(NH_3) = 1.8 \times 10^{-5}$.

a) 4.66 b) 4.72 c) 4.80 d) 4.93 e) 5.14

11. Which of the following aqueous buffer solutions has the highest buffer capacity?

a) 0.10 M NH_3 / 0.10 M NH_4Cl.
b) 0.10 M NH_3 / 0.50 M NH_4Cl.
c) 0.50 M NH_3 / 0.50 M NH_4Cl.
d) 0.50 M NH_3 / 0.10 M NH_4Cl.
e) 0.010 M NH_3 / 0.010 M NH_4Cl.

12. Calculate the pH of a buffer prepared by mixing 500.0 mL of 0.20 M aqueous solution of HF and 500.0 mL of 0.40 M aqueous solution NaF. $K_a(HF) = 6.8 \times 10^{-4}$.

a) 8.43 b) 3.77 c) 2.87 d) 3.47 e) 2.57

13. Calculate the change in pH when 0.03 mol HCl are added to 1.00 L buffer solution that contains 0.60 mol NH_3 and 0.70 mol NH_4Cl. Assume no volume change. $K_b(NH_3) = 1.8 \times 10^{-5}$.

a) Decrease by 0.04 b) Decrease by 0.08 c) Increase by 0.04

d) Increase by 0.04 e) No change in pH.

14. Which one of the following changes would have negative ΔS sign?

a) $H_2O_{(s)} \rightarrow H_2O_{(g)}$
b) Dissolving glucose in water.
c) $2CH_3OH_{(l)} + 3O_{2(g)} \rightarrow 2CO_{2(g)} + 4H_2O_{(l)}$
d) $CS_{2(l)} + 2H_2O_{(l)} \rightarrow CO_{2(g)} + 2H_2S_{(g)}$
e) $H_2O_{(l)}$ at 25°C $\rightarrow H_2O_{(l)}$ at 75°C

15. Given the following data:

	ΔH°_f (kJ/mol)	S° (J/mol.K)
$CH_3OH_{(l)}$	-259	127
$H_2O_{(l)}$	-28(	70.0
$CO_{2(g)}$	-394	214
$O_{2(g)}$	—	205

Calculate ΔG° (in kJ/mol) for the following reaction at 25°C.

$$CH_3OH_{(l)} + 3/2O_{2(g)} \rightarrow 2H_2O_{(l)} + CO_{2(g)}$$

a) – 703 b) - 693 c) -71? d) - 81? e) – 68?

16. Consider the following reaction:

$$COCl_{2(g)} \rightarrow CO_{(g)} + Cl_{2(g)}$$

ΔH° = +109 kJ/mol and ΔS° +137 J/mol.K.
Which of the following statements is correct?

a) The reaction is spontaneous at all temperatures.
b) The reaction is spontaneous at temperature higher than 550 °C.
c) The reaction is non-spontaneous at all temperatures.
d) The reaction is spontaneous at temperature between 100 -500 °C.
e) The reaction is spontaneous at temperature less than 100 °C.

17. Consider the reaction:

$$SO_{2(g)} + H_{2(g)} \rightarrow H_2S_{(g)} + O_{2(g)}$$

$\Delta H^\circ = 278$ kJ/mol and $\Delta S^\circ = 31.9$ J/mol.K.

At 127.0 °C, K_p for the reaction is about:

a) 2×10^{-35} b) 9×10^{-34} c) 4×10^{-33}

d) 7×10^{-32} e) 1×10^{-36}

18. Consider the reaction:

$CO_{2(g)} + H_{2(g)} \rightarrow CO_{(g)} + H_2O_{(g)}$, $\Delta G^\circ = +41$ kJ/mol at 298 K.

Which of the following statements is true about the reaction?

a) The reaction is spontaneous under standard conditions.
b) The reaction is spontaneous under all partial pressures of reactants and products.
c) The reaction is non-spontaneous under all partial pressures of reactants and products.
d) The reaction could be spontaneous if Q_p (reaction quotient) is 10^{-10}.
e) Equilibrium constant for the reaction is greater than 1.00.

Q1: answer is (b)

$2NO + O_2 \rightleftharpoons 2NO_2$

1) reverse: $2NO_2 \rightleftharpoons 2NO + O_2 \Rightarrow \frac{1}{K_c} = \frac{1}{7 * 10^5} = .143 \times 10^{-5}$

2) reduce by $\frac{1}{2}$: $NO_2 \rightleftharpoons NO + \frac{1}{2}O_2 \Rightarrow \sqrt{K_c} = \sqrt{.143 \times 10^{-5}}$

$= 1.195 \times 10^{-3} = 1.2 \times 10^{-3}$ ✓

Q2: answer is (C)

$K_p = K_c (RT)^{\Delta n}$

$K_c = .0472$

$R = .082$

$T = 992$

$\Delta n = 2 - 3 = -1$

$K_p = .0472 (.0821 * 992)^{-1}$

$K_p = 5.795 \times 10^{-4} \approx 5.8 \times 10^{-4}$ ✓

Q3: answer is (b)

↓ conc N_2, ↓ P, ↑ V ⇒ ↑ in product

T ⇒ change k

catalyst ⇒ no effect

Q41 answer is (a) :-

Initial concentration :-

$[COCl_2] = .6 \;/\; [CO] = 0 \;/\; [Cl_2] = 0$

$[COCl_2] = \frac{.6}{1} = .6$

Find Intermediet :-

$$COCl_2 \rightleftharpoons CO + Cl_2$$

.6	0	0
$-x$	$+x$	$+x$

Find concentration :-

$[COCl_2] = .6 - x \;,\; [CO] = x \;,\; [Cl_2] = x$

but $[CO] = .059$ so $\Rightarrow x = .059$.

$\Rightarrow [COCl_2] = .6 - .059 = .541$

$\Rightarrow [CO] = .059$

$\Rightarrow [Cl_2] = .059$

$$K_c = \frac{[CO][Cl_2]}{[COCl_2]} = \frac{(.059)^2}{.541} = 6.43 \times 10^{-3}$$ ✓

Q5) answer is (e) :-

$[IBr] = \frac{1}{4}$

$= .25$

Initial Conc. :-

$[IBr] = .25$, $[I_2] = 0$, $[Br_2] = 0$

Intermediat :-

$2IBr \rightleftharpoons I_2 + Br_2$

.25	0	0
$-2x$	$+x$	$+x$
$.25-2x$	x	x

Final Conc. :-

$[IBr] = .25 - 2x$, $[Br_2] = x$, $[I_2] = x$

$$K_c = \frac{[I_2][Br_2]}{[IBr]^2}$$

$$.0256 = \frac{x^2}{(.25-x)^2} \Rightarrow x = .03 = [Br_2]$$

Q6) answer is (C) :-

NH_3 / $\curlywedge H_2^-$ It reduced the charge and the hydrogen atom from H_2 first

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Q7) answer is (d) :-

$N_2H_4 + H_2O \rightleftharpoons OH^- + HN_2H_4^+$ $\quad kb = \frac{[OH^-][HN_2H_4^+]}{[N_2H_4]}$

$$1.7 \times 10^{-6} = \frac{x^2}{(.2-x)} \Rightarrow x = 5.827 \times 10^{-4}$$

$$[H^+] = \frac{kw}{[OH]^{-1}} = \frac{1 \times 10^{-14}}{5.8227 \times 10^{-4}} = 1.717 \times 10^{-11}$$ ✓

Q8) answer is (e) :-

$HA \rightleftharpoons H^+ + A^-$

.02	0	0
$-x$	$+x$	$+x$
$.02-x$	x	x

ionization : 8% → .08

$x = .08 \times .02$

$x = 1.6 \times 10^{-3}$

$K_a = \frac{x^2}{(.02-x)} = \frac{(1.6\times10^{-3})^2}{.02 - 1.6\times10^{-3}} = 1.39 \times 10^{-4}$

$pK_a = -\log[K_a] = 3.856 \approx 3.86$ ✓

Q9) answer is (9) :-

1) $H_2A \rightleftharpoons HA^- + H_3O^+$

.4	0	0
$-x$	$+x$	$+x$
$.4-x$	x	x

$K_{a_1} = \frac{x^2}{.4-x}$

$2.6\times10^{-5} = \frac{x^2}{.4-x} \Rightarrow x = 3.212\times10^{-3}$

2) $HA^- \rightleftharpoons A^{-2} + H_3O^+$

3.212×10^{-3}	0	3.212×10^{-3}
$-x$	$+x$	$-x$
$3.212\times10^{-3}-x$	x	$3.212\times10^{-3}-x$

$K_{a_2} = \frac{(3.212\times10^{-3}-x)\,x}{(3.212\times10^{-3}-x)}$

$K_{a_2} = x$

$4.2\times10^{-2} = x$

$x_1 >>> x_2 \Rightarrow$ rejected

$pH = -\log[x_1] = -\log[3.212] = 2.49$ ✓

Q10) answer is (c) :-

$NH_4NO_3 \rightarrow NH_4^+ + NO_3^-$

.65 .65 .65

$NH_4^+ + H_2O \rightleftharpoons NH_3 + H_3O^+$

.65	0	0
$-x$	$+x$	$+x$
$.65-x$	x	x

$K_a = \frac{x^2}{.65-x}$

$3.85\times10^{-10} = \frac{x^2}{.65-x}$

$x = 1.58\times10^{-5}$

$pH = -\log x = 4.8$

$K_a = \frac{K_w}{K_b}$

$K_a = \frac{1\times10^{-14}}{1.8\times10^{-5}}$

$K_a = 3.85\times10^{-10}$

Q11) answer is (c)

Q12) answer is(d) :-

$$pH = pKa + \log \frac{[A^-]}{[HA]}$$

$$pH = -\log 6.8\times10^{-4} + \log \frac{-2}{-1}$$

$$= 3.468 \approx 3.47$$

$$1\,[HF] = \frac{500\times10^{-3}\times.2}{1000\times10^{-3}} = -1$$

$$2\,[F^-] = \frac{500\times10^{-3}\times-.4}{1000\times10^{-3}} = -2$$

Q13) answer is (a)

$$pH_1 = pK_b + \log \frac{[salt]}{[base]}$$

$$= -\log 1.8\times10^{-5} + \log \frac{-7}{-6} = 4.81$$

$$pH_2 = pK_b + \log \frac{[salt + [H_3O]]}{[base + [H_3O]]}$$

$$= -\log 1.8\times10^{-5} + \log \left[\frac{-7--.3}{-6+3}\right] = 4.77$$

$$\Delta P = pH_2 - pH_1 = -.04$$

Q14) answer is (c)

Q15) answer is (e) :-

$$\Delta H^\circ_{rxn} = -344 + 2(-286) - \left(\tfrac{3}{2}\times0\right) - (-254) = -707 \text{ kj/mol}$$

$$\Delta S^\circ_{rxn} = 214 + 2\times70 - \left(205\times\tfrac{3}{2} + 127\right) = -80.5 \text{ j/mol.k} = -.0805 \text{ kj/m.k}$$

$$\Delta G^\circ_{rx} = \Delta H - T\Delta S$$

$$-707 - (25+273) \times -.0805 = -683 \text{ kj/mol}$$

Q 16) answer is (b)

$\Delta H(+)$ $\Delta S(+)$

is spontenouse at high Tempreture

Q17) answer is (a) :-

kp so is equilibruim $\Delta G = 0$

$\Rightarrow \Delta G^\circ = -RT \ln kp \Rightarrow kp = e^{\frac{-\Delta G}{RT}}$

① $\Delta G^\circ = \Delta H^\circ - T\Delta S^\circ$

$278 - (127+273) \times 31.9 \times 10^{-3} = 265.24$ kj/mol

$kp = e^{\frac{265.24}{8.314 \times (127+273)}} = e^{\frac{265.24}{2.3102 \times 265.24}}$

$kp = e^{\frac{265.24}{3.3256}}$

$= 2.3 \times 10^{-35} \approx 2 \times 10^{-35}$

Q18) answer is (c)

good Luck

#اسألني عن الوصفة

#أكل الوصفة

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